Real-time Integration of Biological, Optical and Physical Oceanographic Data from Multiple Vessels and Nearshore Sites using a Wireless Network (DURIP)

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LONG-TERM GOALS

Our long-term goal is to quantify the interactions between small-scale biological and physical processes within the upper ocean. This project addresses that goal by providing the technical infrastructure to allow collaborating investigators on separate vessels to share data and conduct adaptive sampling using wireless networking.

OBJECTIVES

Our objective was to link the data streams from nearby vessels and shore stations into a coherent wireless network which would permit collaborating investigators to share, analyze, and discuss field data as data collection is in progress.

APPROACH

We selected and installed commercially available wireless communications instrumentation to connect three oceanographic research vessels and two shore stations, all of which were within a five mile radius during a field experiment in East Sound, Orcas Island, WA. The wireless communication system permitted data transfers at T1 speeds within the East Sound network and to the Internet via a local Internet Service Provider (ISP).

WORK COMPLETED

The wireless system was installed and used during the 1998 Thin Layers Experiment. We connected three oceanographic research vessels and two shore stations to one network (see Figure 1). The local network was then connected to the Internet. The wireless network was kept in place from late May to early August, 1998. During the intensive sampling phase of the field experiment, researchers on each research vessel were able to transfer data to a common server accessible to all users.

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RESULTS

The wireless network functioned extremely well during the entire deployment period. Scientists on each of the vessels had high-speed access to the Internet, and could move data rapidly to and from the network server located at Thistle Point (Figure 1). The Fish Hatchery shore station monitored data acquisition from instrumented moorings and meteorological instruments and those data were automatically transferred (via wireless) to the network server. The data from the profilers on the separate vessels and from the moored instruments were accessible to participating investigators via wireless bridges connected to the local networks on each vessel and at each shore site. Signal strength tests showed that high-speed data transfers were possible up to seven miles over water. Summaries of the field results can be found at the website listed at the top of this report.

The installed system had the following characteristics:

2Mbps data rate
direct sequence spread spectrum which is secure and requires no additional FCC license
up to 10 mile range with directional antenna
3-5 mile range over water with omni-directional antenna
SNMP support
multipoint media access control protocol to eliminate packet collisions

IMPACT/APPLICATION

Our experience suggests that wireless communication systems can provide rapid, on-site, collaborative evaluation of separate data sets collected by investigators on different vessels. The networked data sets from separate vessels and shore stations can provide investigators with the unique opportunity to evaluate biological, optical and physical oceanographic data within moments of data collection, and then develop timely responses to changing conditions.

TRANSITIONS

This project should help with the transition from discrete, separate field experiments/data collection efforts to linked, networked activities that provide remote data sharing and data interaction between scientists at nearby locations. It can enhance our ability to focus our sampling efforts over short time scales and rapidly adapt to changing environmental conditions. In addition, the linked data on a wireless network at a remote site can be connected to the Internet backbone so that investigators at home institutions can participate in the real-time data process. This remote wireless research network provides a model for future deployment of complex field operations which require high-speed, high-capacity networks that can be implemented quickly, provide secure transmission of data within the local network, and provide connection to the larger Internet. We see the application of this wireless network instrumentation in the ongoing East Sound project to be a first step toward continental shelf and open ocean deployments with the next generation of wireless and satellite communication technologies.

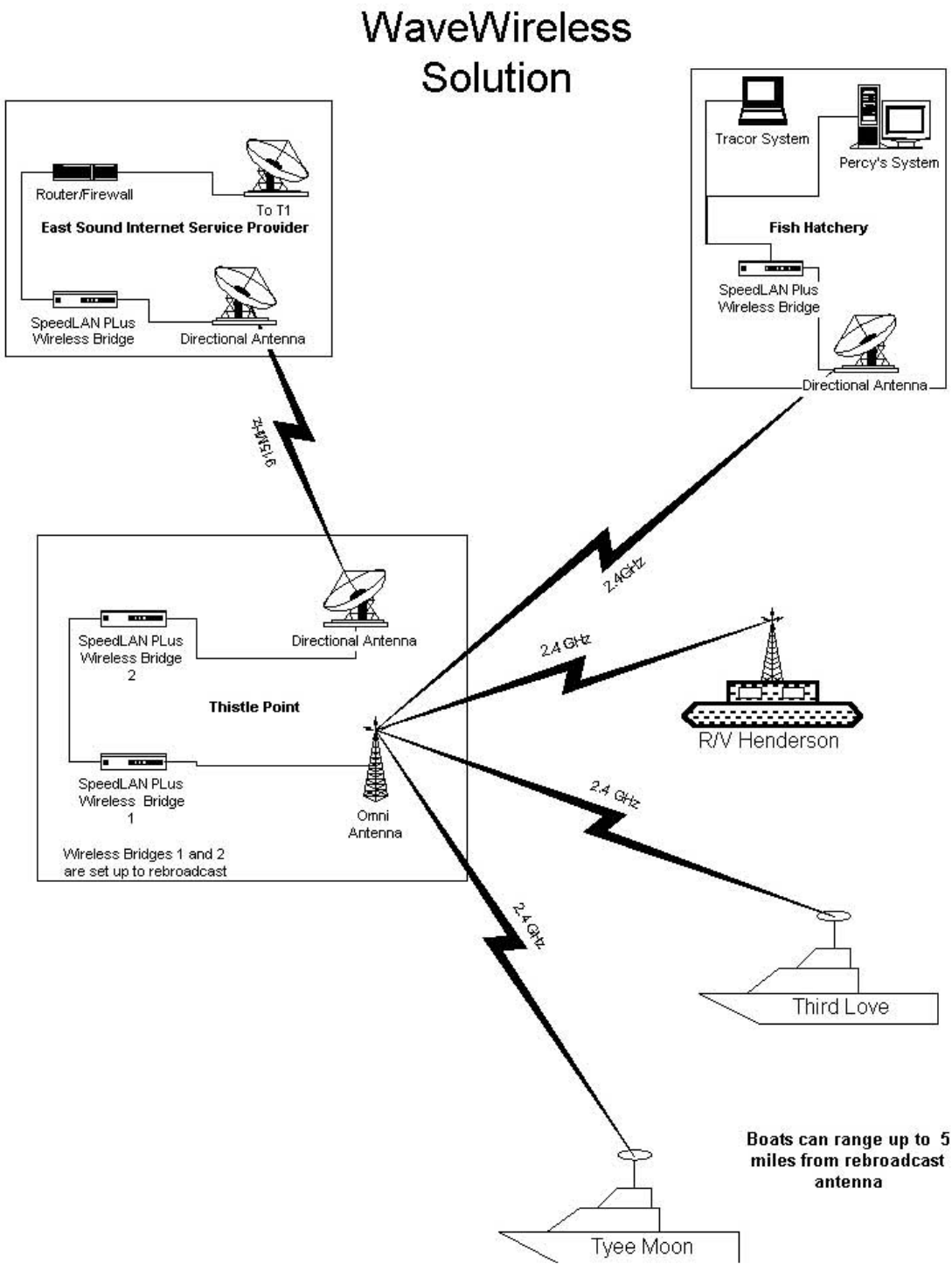

Figure 1. Schematic diagram of the wireless networking configuration used during the 1998 East Sound Thin Layers Experiment.

RELATED PROJECTS

This DURIP proposal is tightly linked to the field efforts of the following ONR Principal Investigators:

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